ICT Use and Network Relations: Exploring Knowledge-sharing Networks in Distributed Organizations

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Abstract

This study of media use and knowledge sharing within distributed organizations addresses two questions: (1) How do people combine different ICTs (information and communication technologies) when they engage in a professional knowledge-sharing network? (2) How are combinations of ICTs used when people engage in frequent as opposed to infrequent relations? Existing research exploring the role of ICTs in distributed organizational settings has tended to focus on single media use and the importance of social capital. As a result, the characteristics and consequences of multiple media use have been largely ignored.

Our study reveals that people combine different ICTs all the time, but they do so relatively less often in the knowledge-sharing network, where they rely more on official channels. We also found that frequent and successful knowledge sharing correlates with each individual's willingness, and ability, to communicate their knowledge assets freely.

Keywords: ICT, professional network, knowledge sharing, multiple media use, GoToMeeting, Outlook groups.

GoToMeeting is a highly rated (*PC Magazine*, 2 July 2007) Web-based tool that allows everyone in a group meeting to share whatever is on each participant's computer. See *http://www.gotomeeting.com*. Outlook groups are a feature within the e-mail program of Microsoft Office Outlook. They enable e-mail discussions on a topic within a group of people. See *http://office.microsoft.com/outlook*.

Introduction

Distributed organizations are ones whose internal activities are geographically dispersed (see Duarte & Snyder, 2006). Increasingly, such organizations are attempting to unify their scattered units into one integrated unit via ICTs (information and communication technologies) as well as via professional networks for knowledge sharing and coordination. Indeed, ICT has become an integral part of the work processes in these organizations. It helps them collect information, process and analyze it, transfer it, and store and present it. It also helps them manage and control equipment and work processes, and

connect people, functions, and units within distributed organizations. The reflexive relationship between actors (people) and the ICTs they use is of particular interest in this paper.

Over the past two decades the field of network analysis within and outside organizational communication studies has grown substantially. But work is still needed in this field regarding theory building (Monge & Contractor, 2003), especially work focusing on organizations that tend to be more collectively oriented with respect to their organization and management (Yuan, Fulk, Shumate, Monge, Bryant, & Matsaganis, 2005). Most research in organizational communication networks has primarily drawn on theories of social capital and trust in connection with media richness and/or virtuality (Dutton, Kahin, O'Callaghan, & Wyckoff 2005; Huysman & Volker, 2004; Jarvenpaa & Leidner, 1999; Kanawattanachi & Youngjin, 2002; Zolin, Hinds, Fruchter, & Levitt, 2004). But that perspective neglects important aspects related to how networks evolve and how they are maintained via ICTs in combination or in multiple media use. While the term "combination of ICTs" refers to the notion of ICTs as a toolbox to accomplish conversations, "multiple media use" refers to the use of ICTs in the context of activities. Sequential use of ICTs, such as e-mail followed up by phone, or vice versa, is an example of planning or persuading activities (Watson, Manheim, & Belanger, 2007).

This paper offers a deeper understanding of the role that media use plays in distributed organizations, especially in networking and knowledge sharing. While a substantial amount of research on network analysis draws on structural arguments and quantitative measures (Shaw, 2006), we sought to address this topic by examining the content of formal and emergent professional networks within a distributed organization. We used an inductive research approach, collecting our data by interviewing members of professional networks in two public distributed organizations in Norway. Thus, this article, which presents the fruits of our research, focuses on public organizations—a contextual area where few studies have been conducted (Munkvold & Akselsen, 2003).

Several researchers have argued for the study of ICTs used in combination (Boczkowski & Orlikowski, 2004; Hesse, Werner & Altman, 1988; Walther & Parks, 2002) instead of the study of media choices as immediate incidents or structuration processes around media (Stephens, Sørnes, Rice, Browning, & Sætre, 2008). In our study we will focus on how ICTs are used in combination or in sequence, or in both combination and sequence, and link this perspective to (1) how these networks evolve, and (2) how they are maintained. One overarching research question prompted this study:

What is the role of ICTs in network relations in distributed organizations?

With the current body of literature on ICTs used in combination in mind we will address the following questions:

a) How do people combine different ICTs when they are engaged in a professional knowledge-sharing network?

b) How are combinations of ICTs used when people engage in frequent relations vs. infrequent relations?

These research questions explore the link between contemporary ICT-use research and research into virtual networks, and networks in distributed organizations and virtual teams in general. The context for this study is an organization that possess the following - formal structures: (1) formal traditional lines; (2) project work and teamwork; and (3) professional knowledge-sharing networks. The latter is the main focus of our own research. So, while research into networks and ICTs in organizations has mainly focused on virtual teams (see Gibson & Cohen, 2003, for an overview), we will focus on ICT use and professional networks for knowledge sharing and coordination—networks with more people and with more undefined goals and tasks (formally) than

the virtual team literature has described so far. Thus, our effort should add useful insights into the complexity of the development and maintenance of knowledge sharing and coordination relations in distributed organizations.

"Combinations of ICT use" can be categorized as multiple media use that occurs either simultaneously (multi-tasking) or sequentially (Stephens et al., 2008). "Simultaneous use" means multiple ICT use at the same time (Stephens et al., 2008), whereas "sequential ICT use" occurs when people communicate an activity or project over time. "Accumulation" provides a third dimension. It occurs when documents (on the intranet, e-mail, or paper) or records on a topic add up over time (Østerlund, 2007), becoming a source of evolving information and knowledge accessible to the individual or to the entire professional network. Since our research questions focus on combined ICT use and frequent vs. infrequent relations, in the next section we will present the theory of ICT use in the workplace and previous research on the relations relevant to our research question.

Theory

The role of theory in inductive and qualitative research has been vigorously debated. According to Glaser and Strauss (1967) and their Grounded Theory approach, prior literature review is unnecessary, but it's definitely required during the final stages of the data analysis and for delimiting the theory (Corbin & Strauss, 2008; Glaser & Straus, 1967), plus it helps the researcher develop a problem statement and remain focused on the theory-generation process. However, when developing theory inductively, it's important that researchers identify what body of knowledge they hope to contribute to. In addition, abstract classical sociological theories can increase one's ability to reflect on the inductive data in the theory-generating process (Layder, 1998). Accordingly, this study will draw on Giddens' (1984) general sociological theory, the Structuration Theory, which has been used for decades now in qualitative technology studies as a tool for reflecting on ICT use in the workplace (see Pozzebon & Pinsonneault, 2005, for an overview). Grounded Theory is a common approach for such technology studies, but often in combination with other sensitizing devices (van den Hoonard, 1997)—e.g., narratives, visual mapping, and bracketing. Our own research is aligned with this qualitative tradition.

Traditional research into ICT use has regarded each ICT as a discrete medium, meaning that research has focused on the pros and cons—the individual characteristics—of each ICT (Daft & Lengel, 1984, 1986; Daft, Lengel, & Trevino, 1987; Rice, 1993). Over the past two decades, however, the concept of "genre" has generated new insights into sequential ICT use. This body of research draws on a practice-oriented view. Yates and Orlikowski (1992) define "genre" as a typified communicative action invoked in response to a recurrent situation. Genres can have either a task-oriented purpose or a social purpose. While Orlikowski (2000) focuses on the structuration processes around a single ICT, others have focused on the combinations of ICT use (Belanger & Watson-Manheim, 2007; Munkejord, 2007; Østerlund, 2007; Stephens et al., 2008).

Network studies, meanwhile, have drawn on the pioneering work of Mark Granovetter (1973) and his notion of the strength of weak ties. "Tie strength," as he defined it, is "a combination of the amount of time, emotional intensity, the intimacy and reciprocal services which characterize the tie" (p. 1361). We aim to contribute to this research area, but our focus will be on conceptualizing the ICT-mediated tie-strengthening activities in the networking process within a formal top-down designed professional network, and especially in what has been labeled coordination by mutual adjustment (Mintzberg, 1979; Thompson, 1967) or relational coordination (Gittel, 2002).

Like us, Haythornwaite (2002) has done work on ICT and network ties and offers insights relevant to our research. She invokes Granovetter's concepts of weak and strong ties in her study of how different qualities of network relations influence ICT use, and of how new ICTs have influ-

enced the development of social networks among researchers and students. She concludes that new ICTs have created challenges for those relations that are weak, since communicators must then depend on common, organizationally established means of communication and protocols established by others. But, she says, any new ICT (both formal and informal) will create new opportunities for making new and stronger ties. In other words, she has articulated the connection between ICT and the development and maintenance of network relations.

The literature on sequential ICT use is pertinent to us, as such use occurs when people communicate during any group activity or project. Researchers have examined the sequencing of message content (Falbe & Yukle, 1992) and decision-making strategies (Pool, 1983; Saunders & Jones, 1990), and also the role of ICT sequences where connecting with others and synchronicity are the underlying attributes (Stephens et al., 2008). The latest work within this research area has developed theories about how people use ICTs in combination (Watson-Manheim & Belanger, 2007), in sequence (Stephens et al., 2008), and accumulation (Østerlund, 2007), adding more insights into the structuration processes in organizations regarding media use in practice in the workplace —that is, working on tasks and in relations. Thus, the study of sequences and accumulation adds to the insights into structuration processes around ICT use in combination—and also enhances our understanding of the complexity of ICT media user, because it sheds new light on how different work conditions influence multiple ICT use.

Since our research questions are explorative, the next section will discuss the qualitative methodology we chose for this study.

Methodology

Grounded Theory (GT) provided our methodological approach here, primarily due to its ability to facilitate and offer explanations and descriptions of complex organizational practice (Sørnes, 2004). Within ICT research, GT has become increasingly popular during the last 10–15 years (e.g., Carlson & Davis, 1998; Orlikowski, 1993). But GT has actually been popular in organizational studies for the last 30 years (Locke, 2001). According to Locke, GT has proved especially useful to researchers investigating organizational topics like decision-making, networks, socialization, and change. In organizational studies in particular, the focus is on group and individual behavior, and this focus captures the initial locus and interactionist tradition of GT (Fardal & Sørnes, 2008; Glaser, 1992; Locke, 2001). This, combined with its analytical and structural properties, helps explain its popularity in organizational research. It also helps us grasp how people structure the way they communicate with each other, which offers useful insights into understanding communication processes and networking.

Research Domain and Participants

Our current study is part of a larger study of distributed organizations in Norway and their professional networks for knowledge sharing and coordination. For our present research domain, we targeted two groups: inspectors at The Norwegian Labor Inspection Authority and taxation officers at The Norwegian Taxation Authority. We targeted them for three reasons. First, both groups of people face complex tasks during the course of inspecting many different organizations. Their mission is to help solve problems ranging from all types of accidents (due to falls, chemicals, misuse of tools, etc.), matters of social and psychological well-being, the prevention of back problems, and so on. Their duties involve inspecting work locations in nearly all sectors of work life within their geographically defined area. It is fair to say, then, that their tasks are very complex and constantly changing. Second, they are distributed both nationally and regionally, with inspectors throughout the country, all of them operating with high autonomy. This is of special interest, because when tasks are complex, uncertainty increases, so more interaction and communication are typically needed (Gittel, 2002). Third, they use ICTs, and have done so for a long

time, to ensure the transfer of knowledge and to coordinate and systematize inspections all over the country, which are intended by law to be "equal."

The locus of our study is the Accident Network (The Norwegian Labor Inspection Authority) in the Northern Norway Region and the Fishery Network (The Norwegian Taxation Authority) in Norway. Members of these networks are regarded as advanced users of ICTs, possibly due to their long success with ICT use, which itself may be due, indirectly, to the daunting size of the region and country.

Sampling Procedure

This study employed the theoretical sampling procedures developed by Strauss and Corbin (1990, 1994) for conducting qualitative analysis. Our chosen respondents have been with their organization for one to 20 years, and all use ICTs to communicate during their workday. We sought data from multiple members of the networks, figuring they could give us different insights into our topic. Newcomers were of special interest to us because presumably they could give us fresh insights into ICT use and networking. More tenured workers, on the other hand, would presumably depend more on previous contacts and the way knowledge sharing and coordination had been conducted before ICTs came on the scene. In this way we hoped to understand the entire evolving picture, not just what is labelled as successful at the outset.

We also emphasized interviewing persons having leadership roles in the networks, not just the rank-and-file members. Our sampling technique mixed wide and narrow sampling (Cutcliffe, 2000). Our sample consisted of participants with plenty of knowledge within a given area, which is characteristic of a narrow sample (Sørnes, 2004). Proponents of this technique argue that one cannot remark on the investigated processes if one doesn't share similar experiences. Conversely, in a wide sample, the respondents might have varied experiences and skills. Such a sampling technique argues for maximum variety in the data (Resnik & Moran, 2002). In this study we employed both techniques to ensure participation from different organizations (wide), but also participants sharing a certain experience related to ICT use (narrow). This sampling technique, of choosing respondents for their similarities as well as for their differences, follows the one recommended by Glaser and Strauss (1967) and Sørnes (2004).

Data Collection

Prior to the data collection, our first author conducted preliminary conversations, from May to September 2008, with the groups' four national and regional managers and also with the four coordinators of knowledge-sharing networks in their respective organizations. The idea was to get a quick first impression of their activities and ICT use. The Fishery Network and the Accident Network were then selected, because for more than four years both networks have been leaders in ICT use and have experienced notable success with it, according to managers in the headquarters of the organization.

Data was collected using semi-structured in-depth interviews, a method that allows for adaptation to each context and individual. The field was not entered with a blank slate— that is, without prior knowledge and preconceptions related to the area under investigation. The semi-structured interviews allowed us to seek a balance between necessary topics and respondents' initiatives; it also provided us with appropriate data and a manageable direction (Strauss & Corbin, 1990). Our research project followed Spradley's (1979) "grand tour guide," with data collection taking place over a period of five months (November 2008 to March 2009). Imitating Spradley's method, our own approach encouraged the interviewees to tell their story—about knowledge sharing, ICT use, and processes in their organizations. Furthermore, the interviewees were well briefed as to our study's aim, and were also given ample time to adjust to the situation. Our first few questions

served as warm-ups so as to make the interviewees comfortable with the interview setting. A total of 13 interviews were conducted with bureaucrats and coordinators in both organizations. Each one lasted 40–95 minutes and was audio-recorded for accuracy and further analysis. Even when some of the interviews lasted up to 95 minutes, we found that the informants remained focused and elaborative.

Due to the long travel distances, 8 of the 12 interviews were conducted by telephone. Although phone interviews are thought a second-best option for obtaining data where social cues are important (Opdenakker, 2006), our phone interviews proved as elaborative as the ones we conducted face to face. One reason for this may have been the informants' familiarity with presenting and elaborating complex matters via the phone, as we will uncover in the data analysis that follows.

Data Analysis

In our study, we used QSR Nvivo 8, a popular tool for organizing qualitative data, and then subjected our data to a Grounded-Theory analysis (Glaser & Strauss, 1967). Following each interview, we read a transcript of it to deepen our understanding of the work conditions, ICT use, and relations. Equally helpful, we also consulted the notes we had taken at initial talks, in between interviews, and at observations of both FTF meetings and virtual meetings.

Then we followed the common steps of Grounded Theory. First, we identified those sentences and paragraphs known as "incidents" in our open coding. This initial process of labeling, conducted in NVivo 8, simplified our synthesizing of the many interviews and provided us insights into our own research questions (see Table 1). The second step, axial coding, involved our combining and collapsing categories. Several times incidents were moved from one category to another. We conducted this process in various ways—in NVivo 8, on paper, on a whiteboard, and in discussions with colleagues. Further on, when the Grounded Theory emerged, we initiated a focused coding (Glaser, 1978) by sorting the incidents into 4 categories and 13 subcategories (Table 2). We then discussed these final categories with representatives of both organizations in the study.

Table 1: Total category listing

1. Telephone meetings	18. Storing
2. Distance in the network	19. Learning with Outlook
3. Experience	20. Management
4. Improvements	21. Equal handling of similar matters
5. GoToMeeting web 2.0 tool	22. Location
6. Input to the network	23. Learning in the field
7. Frequent relations	24. Learning in the network
8. Good old days	25. Learning in projects
9. Intranet	26. Learning with documents
10. Connect people with e-mail	27. Learning with pictures (visualization)
11. Combinations of ICT use	28. Learning via ICT
12. Communication channels in general	29. Mistakes
13. Knowledge	30. Goal
14. The network arena	31. Resources
15. Environment	32. Top-down steering
16. Transfer of knowledge	33. ICT used in sequence
17. Social aspects	34. Combination telephone and e-mail

These categories were further reduced to thirteen and then to four core categories elaborated in our model on context factors for what is going on in the knowledge sharing network (see Figure 1).

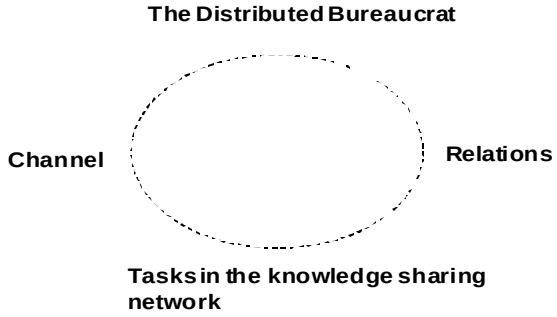

Figure 1. Model on Context Factors

Using Structuration Theory as a Theoretical Framework

To develop theories out of our empirical findings, we use Structuration Theory (Giddens, 1979, 1984), which helped us grasp how relations are handled through the use of old and new ICTs within a knowledge-sharing network. Structuration theory, as a metatheory, provides a way to deepen one's understanding of a given phenomenon (Orlikowski, 1999). In our case, it encouraged us to avoid clear dichotomies like rich vs. poor media channels, strong vs. weak ties, or know-how vs. know-who, and encouraged us instead to look for the intervening relations between them, such as how reduced cues of a medium were compensated by the development of genres within a given medium or by combinations. Likewise, how weak ties could influence strong ties, and how know-how could influence the importance of whom to ask for further information (know-who).

Structuration Theory has been applied for myriad purposes in organizational communication (see Browning et al., 2005, for an overview). A network in this perspective is often on optional pathway for communication and knowledge sharing which an actor can choose to use or not to use (Bø & Schiefloe, 2007). While ICT researchers using Structuration Theory solve the problem with structural determinism by focusing on appropriation (Poole & DeSantics, 1990) or practice (Orlikowski, 2000), network researchers focus on the personal relations (Wellman, 1996). Social structures such as appropriate media use, existing work processes, and existing relations make social action possible, and at the same time social action creates those very structures.

Using Structuration Theory as a metatheoretical framework helps one to grasp the contextual and emergent structure of relations in the professional network one studies. Based on what we have elaborated until now, Structuration Theory creates awareness of:

1) The role of applying structures embedded in the organization, such as existing communication channels, personal relations, organizational culture, professional norms, and knowledge. Since the two organizations we selected are "old" and staffed by professionals, several structures may or may not come into play. Since many of our informants have worked in their organization for as much as 20 years, represent different professions, and refer to them frequently, we regard data on these structures to be present in our findings.

2) The fact that new formal entities, like a distributed professional formal-knowledge network, are open-ended regarding ICT use, development of personal relations, and content

of the communication. The role of this entity will be subjected to an unwrapping process (Røvik, 2007), where the roles of the work in the traditional line or projects may also come more or less into play. "Unwrapping" means that when the bureaucrats start to work within the knowledge-sharing network, their adaptation to this new way of working will be influenced by how similar tasks have been conducted before. From our informants we often found that they would compare how they typically communicate and relate to others in their daily routines or other projects with what occurs in their knowledge-sharing network. Since GoToMeeting and Outlook groups are also the respective official channels and regularly used, we have data where the unwrapping processes of ICT-mediated and distributed knowledge sharing are occurring.

3) The fact that people give meaning and add value to relations and ICT use within the knowledge-sharing network. The experience regarding what is happening now is often mentioned by our informants and how they try to promote it or solve problems. In other words, we regard data on emergent structure to be present in our findings.

The Theoretical Context Factor Model Presented

Our model presents relations between major nodes, including categories within and across nodes. They are interdependent and mutually causal. Any single category, even with few incidents, may influence other categories and nodes. The 4 categories uncovered in our Grounded-Theory analysis represent a synthesis of 13 categories, themselves a synthesis of our initial 34 categories (Table 1). They represent the different nodes on our model for knowledge sharing in distributed organizations. With our research questions in mind, 4 nodes and 13 subcategories emerged from our data affecting media use and relations in the knowledge-sharing network within the distributed organization.

Table 2: Content of Context Factor Presented

Total number of incidents: 226

The distributed bureaucrat (44 incidents)

Independent work (15)

Describes work conditions as individual task handling and independent decision making at small district offices and home offices. For example, describes the inspection situation or taxation-handling processes. Describes also dilemmas regarding helping businesses and equal handling of similar matters.

Learning two by two (24)

Describes inspectors working in pairs, communicating with a colleague in the region, or communicating with an expert at national level.

Experience as core asset (5)

Describes how experienced inspectors or taxation officers work with their environment—e.g.,, collaborating with businesses, branch organizations, or the police after an accident.

Relations (48 incidents)

Frequent relations in the network (12)

Presents people who are in frequent touch within the knowledge-sharing network, such as people with similar tasks, who have been called before, working on a joint project or campaign and/or with useful knowledge.

Infrequent relations in the network (7)

Discusses people whom they don't contact and why—perhaps because they're too busy, too old, or too inexperienced.

Engaging activities (15)

Describes and discusses activities involving people in the knowledge-sharing network, by using e-mail, FTF meetings, involving them in projects and seminars, asking formally for resources (of person's time), and keeping in contact with former members of the network.

Communication Channels (56 incidents)

The use of discrete media (10)

Describes and discusses the use of a single medium, such as e-mail or the phone.

The use of ICT in combination (19)

Describes and discusses the use of ICTs in combination. Most frequently mentioned is the combination of phone and e-mail.

Fixed ICT for the knowledge-sharing network (20)

Describes and discusses the use of GoToMeeting tool (Accident network) or Outlook groups (Fishery Network).

Intranet and databases (7)

Describes and discusses the use of the intranet and databases. Also discusses problems with search engines.

Tasks in the knowledge-sharing network (78 incidents)

Top-down meeting bottom-up (31)

Describes the role of the network in the organization. Like knowledge sharing and development, answers formal top-down questions and giving input into organizational policy. Discusses conflict between initiating own policy vs. implementing top-down policy. Formal documents are also added here as data.

Learning activities in the network (30)

Describes the learning processes regarding change of routines, case handling, storing data, and branch knowledge. Includes the combination of knowledge of legislation and branch knowledge in use.

Desired future (17)

Discusses how the knowledge-sharing network should have been conducted, such as better management of meetings, more concrete projects, and more resources (time). Also discusses dilemmas regarding too many participants in the network vs. the fact that many case handlers aren't members or aren't participating in the network.

The distributed bureaucrat

Our first category, "The distributed bureaucrat," comprises 44 incidents. Under this category, the various subcategories are elaborated under the rubrics "Experience," "Good old days," "Knowledge," "Location," "Learning in the field," and "Resources" (Table 1). The interviews coded within this category elaborate on the work conditions facing the distributed bureaucrat. Briefly,

those conditions include distributed independent work-task handling that is often conducted alone; facing dilemmas regarding case handling, such as combining juridical assessment, professional knowledge, local knowledge, and/or changing branch knowledge; and ensuring equal handling of the same or similar matters nationwide.

Older inspectors within the National Labor Inspection Authority told us that, in earlier years, they had worked alone in their district. Eventually, district offices were set up in areas to which at least 5-6 people could commute. While case handlers at the Norwegian Taxation Authority work mainly from distributed Taxation Offices, the inspectors in The National Labor Inspection Authority often work several days a week from their home office. The first author also experienced an effect of this phenomenon while observing a virtual meeting (GoToMeeting Web 2.0 tool) in the Accident Network. That day, too many people were working from home, making it impossible for everyone to join the meeting. Its organizer had expected several people to be participating directly from the district offices and so hadn't ordered enough lines for the meeting. This experience illustrates the independent and solitary actions of the inspectors. On the other hand, even though many are working from home, the organizer, a manager who had worked in the organization for only a few months, assumed that the staff (or at least some staff) commute to, and work from, the district offices every day. This obviously wasn't true that day, so the meeting had to be postponed for a month.

The nodes labeled "Experience," "Knowledge," and "Learning in the field" (Table 1) elaborate on formal knowledge (of the law, accounting, engineering), the help of mentors and colleagues in conducting inspections, the sharing of knowledge of local conditions, branch knowledge, and the experience of collaboration with other authorities. They also address how best to conduct case-handling processes within the mother organization and in collaboration with businesses and other authorities. While inspectors sometimes work in pairs when conducting inspections, taxation officers handle cases alone, relying on reported figures and written documents regarding each case, as well as on branch knowledge, taxation legislation, and branch legislation. Both inspectors and taxation officers collect and make their own case-handling decisions, doing so as correctly as possible according to legislation and the precedent of similar cases, and also sometimes after conferring with colleagues.

Since both inspectors and taxation officers collect the facts and make their own case-handling decisions, direct relational coordination isn't needed for each case. Coordination efforts tend to emerge, though, whenever businesses (users), colleagues, or the mass media point out unequal handling of similar cases. Then the inspectors and taxation officers communicate about it a lot on e-mail. If necessary, further discussions will take place face to face on how to address the problem, which might involve creating policy, fresh guidelines, or a new routine.

Equitable case handling is challenging for both inspectors and taxation officers alike. Sometimes it's hard owing to different interpretations of legislation or whatever context information is at hand (local knowledge, branch knowledge, the type of business, technical questions, etc.). For the inspectors it's also hard to apply all the formal rules and instructions and, at same time, conduct inspections that are helpful for the business. The inspectors' role, one must understand, is to promote improvements in the organization, not control it. The following comment by an inspector illustrates this well:

> *This discipline—inspections, the whole process—is very similar to a sales process. Once upon a time we made a questionnaire—one of the best in Norway regarding chemistry. We were asked to use it—ask question number one first and so on (of course with a presentation first)—but nobody had followed up the new legislation. Therefore we had to ask them what they are doing now to take care of the working conditions. Then the commu-*

nication picks up … You can't ask the first question regarding if they have evaluated risk in their business because then they get defensive and ashamed.

The category "Resources" (Table 1) elaborates on the lack of time for knowledge sharing. The distributed bureaucrat has to conduct as many inspections as possible in an area or as many taxations as possible within a year—and sometimes contribute to projects, too. Resources (time) for knowledge sharing are limited for the distributed bureaucrat. Members of the knowledge-sharing network have earmarked some time (around 10% in the National Labor Authority), but very often these people are busily engaged in many activities, so the real time spent can vary. The category "Good old days" (Table 1) represents the view of the older men in the Accident Network who look back to an era when they could call on experts in Oslo and ask them about legislation and specifications regarding technical issues and equipment. But now, after reorganization, each region is supposed to have this expertise covered locally.

Relations

The second category, "Relations," comprises 48 incidents. Under the category "Relations," the following subcategories are elaborated: "Frequent relations," "Learning with documents," "Learning in projects," "Connect people with e-mail," "Distance in the network," and "Transfer of knowledge" (Table 1). The interviews here elaborate on relations defined by the tasks that the bureaucrats must handle. People relate to each other on the basis of what they perceive others can and are willing to contribute to their work—that is, to their handling of inspections or taxations. The category "distance in the network" (Table 1) presents variables that reduce the probability of strong ties. These include a lack of engagement, age difference, different professions (making communication more difficult), and same profession (same knowledge).

In the interviews, knowledge is described as an important factor for keeping people in touch. The distributed bureaucrat is driven by his need for advice as to the proper process to use, and what facts are needed, to handle a given case properly. This tie, the knowledge tie, is what keeps some people in frequent contact, and others in more infrequent contact.

In our data, informants who were formal members of a knowledge-sharing network elaborated on "Frequent relations," "Learning with documents," "Learning in projects," "Connect people with e-mail," and "Transfer of knowledge" (Table 1). According to them a knowledge tie can be defined by these factors:

1) People handling similar cases.
2) People who have or have had a formal role in the knowledge-sharing network.
3) People who've participated in joint projects, seminars, or campaigns.
4) People who are engaged in the core group of the formal knowledge-sharing network.

If you're handling similar cases, you're interested in exchanging information about them for several reasons. You seek information about which facts are needed to process your case and what solution or outcome is possible for it. You look for help from your colleagues, hoping to locate them in databases. Since these databases are often not as user-friendly as you'd like, you exchange case numbers (so you can find them yourself) or whole documents that may be similar to the case others are working on. People who have participated in the knowledge-sharing network previously are also regarded as an asset. Projects, seminars, or campaigns are also bonding activities, and are used deliberately to involve and engage people.

"On-and-off relations" crop up often in our interviews. People will from time to time be engaged in the same projects and campaigns. In each of the knowledge-sharing networks we studied, there existed a core group. One inspector explained: "*Yes, we are three to four people who are more*

active than the others. This means that I participate at most of the meetings and contribute with questions and solutions to the coordinator."

While knowledge is the most frequently mentioned tie factor, social aspects get mentioned four times—for example, the sorrow felt when people leave the network after a reorganization, the fun of seeing colleagues at physical meetings, and the effort some people make to remember each other's birthdays. One also talked about being a mentor for another over a distance: "*Then I learned that there is no impossibility to meet each other without seeing each other. With technology in our ear [a phone] … and my legs on the table … the conversation further develops the social and the fact that we are helping each other*."

The category "Mistakes" (Table 1) elaborates the need to know colleagues well enough to discuss and learn from their personal mistakes. During the early period of the "Fishery Network" they could do this, but today, due to reorganization and an influx of new people, this isn't possible, at least yet. Under the category of distance, the category "Frequent and infrequent relations" (Table 1) is further elaborated upon. Experienced people tend not to contact others. Said one network member: *"Do you cope with the job by yourself? Then you don't contact other people. Some are in touch more often … due to that it isn't their profession*." Others noted that their older and more experienced colleagues are less interested in contributing, because they don't get as much out of the knowledge-sharing network.

"Other networks" (Table 1) are important for the lawyers, their own network "lawyers' forum," and other lawyers in general in both organizations. Inspectors and taxations officers often mention people they have contacted before, including people at the national level or county level, and other groupings like "The minding group," and the Chemistry Network, people with the relevant knowledge to accomplish their tasks.

The important insights into relations here add up to the individualistic nature of the distributed bureaucrat elaborated in our category by that same name. While ICTs reduce distance and contribute to knowledge-sharing relations for some, the exchange relations of knowledge are often related to case handing. Bureaucrats already possessing the necessary knowledge don't see the benefit of contributing to the knowledge-sharing network, since they don't get anything personally useful for case handling out of it. This category also underlines the importance of the perceived knowledge of colleagues, relevant to one's own case handling, for developing knowledge-sharing relations.

Channels

The third category, "Communication Channels," comprises 56 incidents. The interviews within this category elaborate on several communication channels more or less defined by the tasks that the bureaucrat has to handle linked to his or her work and to the work in the knowledge-sharing network.

Under the category "Communication Channels" we have the following subcategories: "Media use in combination," "Telephone and e-mail," and "Telephone meetings" (Table 1). Here, the multiple uses of media are elaborated. The communication channels mentioned are GotoMeeting, e-mail, telephone, face to face (FTF), archives, and intranet. While Go-to- Meeting is the main channel in The Accident Network, phone meetings, FTF and Outlook groups are the dominant channels within the Fishery Network.

Individual giving and receiving preferences for media use. Telephone plus e-mail is the combination used in both organizations in their ongoing task handling. Often they'll e-mail a document and then pick up the phone to discuss it. People in both organizations use both mediums all the time. Phones are regarded as suitable when documentation isn't needed and when there is a sense of urgency, or if the question requires more elaboration and discussion. Those who have

worked in the organization for several decades say that the phone is used less these days due to e-mail. If the distributed bureaucrat has time to wait for an answer, then e-mail is regarded as the proper communication channel, because people are often very busy and require a convenient opportunity to respond. This leads us to another interesting finding. People sometimes like to be asked a question via one channel and then answer it via another channel. One respondent put it this way:

> *"The fastest [method] for me is to explain at the office [i.e., FtF or via the phone]. Then you can ask control questions as well. E-mail takes more time [because it involves writing]. In writing is a large process, but it is hard for people to recall all the details [which is why they prefer e-mail]… [for their convenience] I ask them to take notes …"*

Others, on the other hand, say that they prefer to ask questions via e-mail, where they can attach relevant documents and refer to them. This adds an insight into the communication process in general. While classical communication theory focuses on communication problems due to coding and decoding errors of the messages, here the sender decides the channel, for his own convenience, and so the receivers must ensure that their response to the communication is made even if this is a less suitable channel for them. In this case, the sender helps the receiver in this process. While one lawyer helps the receiver to take notes, others use attachments to place the question at issue in context. These actions are used to fulfill the purpose of the communication and to communicate efficiently, to help each other to get it correct the first time or to contextualize the question.

GoToMeeting as a fixed combination. GoToMeeting is a Web-based conference tool that allows a whole group to communicate via phone and screen (to present documents) collectively, simultaneously. "Same-time chat" is used to bring up questions while somebody else is talking; it's similar to raising your hand at a FTF meeting. GoToMeeting is a fixed combination of voice and screen, so to speak. The tool opens up everyone's PC for sharing documents, PowerPoint presentations, archives, or whatever else needs accessing and discussion.

The category GoToMeeting elaborates on how this tool is used in the knowledge-sharing network. One Inspector tells us what is going on:

> *Most of it [communication] is by GoToMeeting … We discuss the assessment of accidents … when we are at the site, afterwards, and when we get police cases, and so forth …. And we can have a GoToMeeting meeting and correct a routine …*

Another Inspector could not be happier with the tool:

> *… in my view, this tool is the same as a FTF meeting … except to look each other in the eyes … when we have met before we didn't need the Id which covers a part of the screen … a good loudspeaker on the phone … nothing hot and irritating … is also very important. It is better than face to face (FTF) because at an FTF meeting you can't that easily present documents and pictures.*

But are they listening? Within this category there are also several critical voices. One Inspector elaborates on this:

> *The problem is that we don't know what people are really doing. Somebody sits maybe by a private telephone while sitting in a conference [GoToMeeting], they have turned off the mic, there is an incoming phonecall and they pick it up. So … there are so many factors influencing on our GoToMeeting meetings … but at a FTF meeting [we are more focused*].

Another Inspector elaborates on this from another point of view:

> *"I do not at all think that this is working. Suddenly we get a direct question, then we think, wow, do they know that we are here?"*

These quotations represent two different stories. While the GoToMeeting tool offers a fixed platform for the combination of several ICT mediums—phone, PowerPoint, archive, and databases, which are very useful for learning purposes—multitasking is also taking place. When people are connected but doing other things, such as answering other phone calls, they don't feel that they are "seen." This in turn reduces the feeling of being there together for a joint purpose.

"Outlook" groups. While the Accident Network has GoToMeeting as their main channel, the Fishery Network uses Outlook groups. In the Fishery Network, when somebody has a general question or has to produce a policy declaration, they'll send the question by e-mail to the whole group for further discussion. If it proves difficult to reach a conclusion via e-mail, the discussion is moved onto the phone or an FTF meeting. This is an example of groups using media in sequence at the group level to solve a question.

But when will they answer? One problem often mentioned is the asynchronicity of participation in the discussions. People will often not join in the discussion until the eleventh hour, so to speak. Discussions tend to fall into several phases, with some people contributing their thoughts early on and others waiting until near the end to chime in. Then it can be hard to end the discussion, for new points of view need to be debated.

Often e-mail discussions can seem endless, too. A man in the Fishery Network comments on this:

> *It can take many rounds; to me it can be difficult to follow it up. Somebody else took my role … the emails can go ten times around. (I do not exaggerate.)*

While the problem in the Accident Network is to keep the network members' attention at the GoToMeeting meetings, the problem with Outlook discussions is that they can seem interminable. In both organizations they have the same solution for the two different challenges. In the Fishery Network often 3 or 4 people have an initial discussion either by phone or by e-mail, or in combination, and they present their consensus view to the rest of the group for further elaboration. In other words, group size is here regarded as the core of the problem, even though both the medium in use and the organizational context are different. Another combination is the combination of FTF and access, and sharing of documents. Every year the Fishery Network meets by FTF and works together on their computers, sharing screens, and with access to all databases and archives.

Tasks in the knowledge-sharing network

Under the category "Tasks in the knowledge-sharing network" we have the following subcategories: "The network arena," "Learning with Outlook", "Equal handling of similar matters," "Learning in the network," "Learning with pictures," "Mistakes," and "Top-down steering."

In both networks there are many similarities, such as similar agendas for knowledge sharing. These agendas might include discussing concrete examples of inspections or cases, focusing on equal handling of similar matters, answering top-down questions and hearings, creating guidelines, and inputting to the policy of the organization as a whole. But while cases are presented and experiences are shared, it can be difficult to share. One Inspector complained:

> *There is not always any point to address the question. We are too rigid in our case handling. The legislation is there. We can have our view about the interpretation of the legislation … It can be difficult to address the question.*

In this context of top-down initiated tasks and people who hesitate to address questions that might illuminate the gap between saying and doing, the knowledge-sharing network turns out to be more a tool for top-down steering than for knowledge sharing in the organization.

People often commented on how the knowledge-sharing network should have been conducted, mentioning such things as better management of meetings, more concrete projects to discuss, and more resources (e.g., time). They also mentioned problems arising from having too many participants in the network, plus other problems arising from the fact that many case handlers either aren't members or aren't participating in the network. These topics were addressed in both networks.

Discussion

The first research question raised here is, "How do people combine different ICTs when they engage in a professional knowledge-sharing network?"

Our research has found that distributed bureaucrats use different combinations daily for particular purposes. They'll use the phone to convey urgent messages, to discuss case handling, and to engage people. They'll often use e-mail to confirm or sum up what has been agreed upon. (This is an example of sequencing of message content related to media choice.) While the combinations in the Accident Network were a fixed combination in itself, involving phone and screen sharing and a platform for further combination, the Fishery Network used e-mail and Outlook groups as platforms for their knowledge-sharing network.

The GoToMeeting tool seems to serve several purposes and deepens our understanding both of this ICT and of combinations in knowledge sharing in general. Its purposes include the following:

1) To gather the whole distributed network at the same time, on phone and on screen.

While the Accident Network has these features built into the tool, the participants within the Fishery Network have created similar work conditions by meeting face to face in Oslo and bringing along their own PCs, which lets them jointly access all the same documents, databases, and archives during a meeting.

2) To discuss topics ranging from equal handling for similar matters to responding to top-down hearings.

In both networks these are the main points of the knowledge-sharing network besides knowledge sharing in itself. While these discussions were conducted on the GoToMeeting tool in the Accident Network, the Fishery Network conducted them at FTF meetings or in Outlook groups.

3) Learning from case-handling processes: Present the whole case-handling process, visualized with pictures of accident sites and communication that had taken place (access to formal letters, questions, and answers) with various actors in process (e.g., the business where the accident took place, the police and various others who were involved, etc.).

4) ICT learning: To help or guide each other—to show where to find similar cases in the archives or databases, etc.

In the Accident Network this is achieved by showing others how to access different sources, using the GoToMeeting tool. In the Fishery Network, they relied on an old and often informal activity—the exchange of case numbers by e-mail or e-mail attachments. Within the knowledge-sharing network, Outlook groups were set up to store relevant fishery-handling cases. Outlook group discussions in this study provide insight into combinations labeled "accumulation" (Østerlund 2007), because the purpose of the activities in the media includes both discussion and storing of arguments and also what has been agreed upon. These e-mails are also sometimes used further when the discussions within them prove relevant to categories of cases.

While the GoToMeeting tool affords several options, success is not yet achieved. A reason for this is that there are no incentives to store the information gathered. The Intranet is rarely used, and the Accident Network doesn't have any intranet for the network. Everything is dependent on dispersed written materials and on members' ability to recall. One explanation is that since everyone has to document stuff all the time, any new documenting tasks would contribute to overload.

The second research question addressed here is, "How are combinations of ICTs used when people engage in frequent relations compared with the infrequent relations?"

In the knowledge-sharing network, each person's knowledge assets are seen as the main motivation for engaging in frequent relations. Haythornwaite (2002) concludes that new media have created challenges for those relations that are weak, due to the dependence of an organizationally established means of communication and protocols established by others. Our research adds to this insight by addressing contextual factors reducing the GoToMeeting tool's ability to help network participants gain an understanding of each individual's knowledge assets. These factors include:

a) Independent work conditions, two-by-two learning tradition, and experience (sticky and tacit knowledge) as the core competence.

b) Infrequent relations in the network. Some people don't communicate other than at a formal meeting. Even there, they are often silent, and a meeting may lack engaging activities (e.g., joint project work). So their knowledge assets prove difficult for others to measure or learn from; at the same time, they may also have difficulty grasping the knowledge of others. The emergent "multi-tasking" that characterizes a typical GoToMeeting meeting can add to a vicious circle of reduced engagement in the network.

c) Activities and people in the network often seem irrelevant to the ongoing task handling confronting each bureaucrat.

On the other hand, involving people in ongoing work is a prime way to increase their engagement. When participating in a project or planning a seminar, various ICTs might be used, such as phone calls, phone meetings, e-mails, GoToMeeting, and ties to former members of the knowledge-sharing network, and a sense of engagement is maintained by such activities. While Gittel (2002) argues that complex tasks encourage networking activities and relational coordination, we found the very opposite to be true here, a result of participants' rigidity or desire for autonomy and their wish to avoid addressing certain questions, and also a result of individual bureaucrats preferring to solve their own problems independently. On the other hand, joint tasks such as projects contribute to networking within the network, and such strategies are used to involve everyone who is present.

Conclusion

To combine ICTs—for example, to be able to talk, read and write at the same time—is important for knowledge sharing in the public organizations we studied. The ability to combine ICTs may be built into the actual tools used (e.g., GoToMeeting), or accomplished by face to face meetings, or be as simple as when two or more people pick up the phone and read and correct the same document at the same time.

In a knowledge-sharing network, frequent and infrequent relations are relevant to the know-who aspect. Frequent relations are defined here as relations with more contact than the formal meetings. In a distributed knowledge-sharing network, each member's knowledge has to be communicated freely for true knowledge sharing. Due to several factors, including consequences of multitasking, this does not work in the Accident Network. Our research shows that group size is per-

ceived as the real core of the problem, even though the medium in use is different and the organizational context is different. While ICTs reduce the distance and, for some people, contribute to knowledge-sharing relations, the exchange relations of knowledge are often related to case handling. Bureaucrats with the necessary knowledge often don't see the benefit of contributing to the knowledge-sharing network, since they don't get out of it anything personally useful for case handling. This also underlines the importance of the perceived knowledge of colleagues, relevant for one's own case handling, for developing knowledge-sharing relations. So all of this calls for not one single medium or a fixed platform of combinations, but for joint tasks and engagement where several ICTs are in use. It is primarily in project work or in task handling that people get to know each other and learn from each other.

Prior research has found that the success of knowledge-sharing networks depends on having good management, a narrow topic, few participants, more pay-back than contribution, an updated intranet, new topics, and reasonably regular face to face meetings (Lave and Wenger, 1991, Sørensen et al., 2008). Our research would add to this list the following essentials: the ability of participants to write, read, and talk at the same time; the ability (and desire) of each participant to communicate his or her knowledge freely to the group; and somehow getting present and former members involved in an ongoing project so as to create a feeling of togetherness.

New research on knowledge sharing, in a media use perspective, should further investigate how sequential and parallel use of multiple media influences people's ability and willingness to share knowledge, considering different preferences by senders and receivers. Testable propositions on media use and relations we suggest: 1) As the relations are frequent, several combinations of ICT are used for knowledge sharing, 2) As the relation is "on and off", the perception of the other`s knowledge assets are more dependent on the media used conducting joint tasks.

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